

**SECTION 300:
SANITARY SEWER
CONSTRUCTION STANDARDS**

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301 GENERAL

The standards and requirements found in this article are for the materials and construction of sanitary sewers within the City of Naperville, Illinois.

301.1 SEWAGE COLLECTION AND TREATMENT

All sanitary sewage of domestic and other water borne wastes shall be collected and conveyed in a sanitary sewer pipe system to a point of discharge into an existing sanitary sewer system, City of Naperville interceptor, or sewage treatment plant. No sanitary sewage shall be allowed to enter any storm sewer system or discharge onto the ground or into receiving streams without first being treated in accordance with city, county, state and federal regulations.

301.2 SPECIFICATIONS

These specifications cover pipe for sanitary sewers and service connections, sewer fittings, manholes and all appurtenances normally used for sanitary sewer collection systems. Special considerations will be covered in the detailed plans and special provisions covering the proposed construction. Sanitary sewers shall be installed in accordance with the "Standard Specifications for Water and Sewer Main Construction in Illinois", latest edition, and applicable ordinances of the City of Naperville, except as modified herein.

301.3 REGULATIONS

Additional rules and regulations governing the construction of sanitary sewers in the City of Naperville are:

- a) The Sewer Permit Ordinance
- b) The Sewage and Wastewater Control Ordinance
- c) The restrictions, policies, and instructions that may be adopted or issued by the City of Naperville
- d) The Illinois Pollution Control Board Regulations
- e) The Environmental Protection Act

301.4 START OF CONSTRUCTION

The contractor shall not begin construction until all required permits have been obtained. Copies of all permits obtained by outside agencies must be provided to the city prior to the start of construction.

301.5 UTILITY IDENTIFICATION

A wood stake (4 inch by 4 inch by 6 foot) stake with not less than the top 2 feet painted green shall be installed next to each sanitary sewer manhole, clean-out, and at the end of each sewer stub (termination at the end of the line). The 4 inch by 4 inch by 6 foot stake shall be maintained in a plumb position until City acceptance of the utility structures.

When newly poured curbs are installed, the contractor shall use a City approved stamp to indent the wet concrete with an "S" to identify the location of each sanitary manhole and sewer stub. The letter "S" shall be indented at the top of the curb 1-1/2 inches to two 2 inches in height and width at a depth of 3/8 inches.

In areas where new curbs are not present or if the developer and/or the contractor fail to indent the curbs as outlined above, the City will then require that identification symbols as approved by the City Engineer be cut into the curb.

302 MATERIALS

302.1 MANHOLES

Manholes for sanitary sewers shall have a minimum inside diameter of 48 inches and shall be constructed of precast concrete units in accordance with ASTM C478-05 (or latest edition) and Section 32 of the "Standard Specifications for Water and Sewer Main Construction in Illinois," and shall follow the City of Naperville sanitary sewer standards. All manholes shall be water-tight. All visible leaks shall be sealed in a manner acceptable to the City Engineer.

302.1.1 FRAME AND COVER

Manholes shall be furnished with a self-sealing frame and solid cover (Neenah Foundry R-1772, East Jordan Iron Works 1022-Z3, or equal approved by the City Engineer) with the word "Sanitary" imprinted on the cover in raised letters (see Naperville Standard Detail 390.03). All frames and lids shall meet or exceed AASHTO H-20 loading specifications. Frames shall be shop painted with asphaltic base paint.

Both the manhole frame and cover shall have machined horizontal and vertical bearing surfaces. Inverted manhole frames are not allowed.

Pick holes shall not create openings in the manhole cover.

302.1.2 WATER-TIGHTNESS

Bolt-down frames shall be used in areas subject to flooding and where indicated on the plans. Bolt-down frames and covers shall be Neenah Foundry R-1916-F, East Jordan Iron Works 1040 ZPT or equal approved by the City Engineer. Frames are to be bolted to cone and cover to frame using stainless steel anchor bolts.

A continuous layer of non-hardening, preformed bituminous mastic material, Conseal 102B or approved equal, shall be applied to each manhole barrel cone and top section to provide a watertight seal.

Rubber boots/seals must be used where pipes enter manholes. The internal connection shall be dressed up with non-shrink hydraulic cement. Hydraulic cement, mortar, and concrete must be of the strength and water-tightness quality as specified in the ASTM standards.

Lifting holes that extend through the wall of manhole shall not be allowed.

302.1.3 FRAME ADJUSTMENTS

Manhole frames shall be adjusted to proper grade using composite material rings as approved by City Engineer. Bricks, rocks, shims, or concrete blocks are not be allowed. Tapered composite adjusting rings, as approved by City Engineer, shall be required when the frame will be with a roadway area. No dressing or tuckpointing mortar is allowed on rings. Final frame adjustment for manholes within the roadway area shall be in accordance with Sections 602 and 603 of Standard Specifications for Road and Bridge Construction, prepared by the Illinois Department of Transportation, latest edition.

All manhole frames and adjusting rings shall be securely sealed to the cone section or top barrel section of the manhole using resilient, flexible, non-hardening, preformed bituminous mastic material, Conseal 102 B or approved equal. The mastic shall be applied in such a manner that no surface water or ground water inflow can enter the manhole through gaps between the top barrel section or cone section and the first adjusting ring, between adjusting rings, or between the last adjusting ring and the manhole frame. Up to 12 inches of adjusting rings may be installed on a given manhole. No more than one 2 inch adjusting ring, and no more than two adjusting rings in total shall be used.

302.1.4 STEPS

Manhole steps on maximum 16 inch center shall be furnished with each manhole, securely anchored in place, true to vertical alignment, in accordance with the Naperville Standard Details. Steps shall be copolymer polypropylene reinforced with ½ inch A615/A615M-05a (or latest edition) Grade 60 steel reinforcement, meeting or exceeding ASTM C 478-05 (or latest edition) and OSHA standards.

302.2 PIPE TO MANHOLE CONNECTOR

A flexible pipe-to-manhole connector shall be used for the connection of the sanitary sewer to precast concrete manholes. The connector shall meet ASTM C923-02 and ASTM A167-99(2004), or latest edition, and be constructed of EPDM rubber with 304 or 316 series stainless steel connectors (KOR-N-SEAL by NPC, PSX by Press-Seal Gasket Corporation, or approved equal).

302.3 PIPES

All sanitary sewer pipe materials shall conform to the latest applicable ANSI, ASTM, AWWA, AASHTO, or other nationally accepted standards. Only the following sanitary sewer pipe and joint materials are approved for use in the City of Naperville, Illinois:

- a) Class 50 ductile iron pipe conforming to ANSI/AWWA C151/A.21.51-02 (or latest edition) with joints conforming to ANSI/AWWA C111/A.21.11-00 (or latest edition). Ductile shall be encased in polyethylene encasement in accordance with ANSI/AWWA C105/A21.5-99 (or latest edition).
- b) Polyvinyl chloride (PVC) pipe (6 inch -16 inch) conforming to ASTM D2241-05 (or latest edition) (SDR 26 – sewer depth between 4-20 feet and SDR 21 for depths between 20-25 feet) with joints conforming to ASTM D3139-98 (2005) or latest edition.
- c) Also acceptable in lieu of ASTM D2241-05 are C900 (SDR 18) for 12 inch diameter sewers and C905 (SDR 25) for 14 inch through 18 inch sewers.

302.3.1 PVC PIPE

This specification is appropriate for PVC pipe (6 inch - 16 inch) complying with ASTM D2241-05 and ASTM D3139-98 (2005) or latest edition. Any proposed PVC pipe greater than 16 inches in size must be approved by City Engineer prior to use. PVC pipe cannot be used in

Class V soils (i.e. organic silt, organic clay and peat) as defined according to the Unified Soil Classification System in ASTM D2487-00 (or latest edition). Solvent cement joints will not be allowed in the City of Naperville.

Pipe shall be clearly marked as follows at intervals of 5 feet or less:

- a) Manufacture's name or trademark and code
- b) Nominal pipe size
- c) The PVC cell classification, for example 12454-B
- d) The legend "Type IPS SDR-26 PVC 1120 Sewer Pipe"
- e) This designation "Specification D-2241"

PVC Pipe shall be SDR 26. For sewer depths between 20 and 25 feet, SDR 21 shall be provided. Higher SDR numbers will only be allowed with the approval of the City Engineer.

302.3.2 PVC FITTINGS

All PVC fittings shall comply with ASTM F1970-05 (or latest edition) and fittings shall be clearly marked as follows:

- a) Manufacturer's name or trademark
- b) Nominal size
- c) The material designation PVC or IPS (iron pipe size), and this designation "Specification D2241"

Fitting shall be molded for pipe sizes between 6 inches and 8 inches in diameter, and fabricated fittings for 10" to 16" in diameter. A minimum of 150 psi pressure class shall be provided.

PVC fittings shall be SDR 26. Higher SDR numbers will only be allowed with the approval of the City Engineer. Fittings shall be required to pass the same inspection and testing requirements of the PVC pipe.

302.4 CONNECTING DISSIMILAR PIPE MATERIALS

Joints connecting dissimilar pipe materials shall be made with sewer clamp non-shear type couplings; Cascade CSS, Romac LSS, Fernco, Inc. Shear Ring, or approved equal. When available, a standard joint with a transition gasket may be used. The name of the manufacturer, class, and date of issue shall be clearly identified on all sections of pipe. The contractor shall also submit bills of lading, or other quality assurance documentation when requested by the City Engineer.

302.5 CASING PIPES

All steel casing pipe shall be bituminous coated, a minimum of 30 mils thickness inside and out, shall be of leak proof construction and capable of withstanding the anticipated loadings. The minimum wall thickness for the casing pipe shall be in accordance with Table 300-1. The steel casing pipe shall have minimum yield strength of 35,000 psi and shall meet the requirements of A139/A139M-04 (or latest edition), Grade B. Ring deflection shall not exceed 2% of the nominal diameter. The steel casing pipe shall be delivered to the jobsite with beveled ends to facilitate field welding

**TABLE 300-1
REQUIRED CASING PIPE WALL THICKNESS**

Steel Casing Diameter	Minimum Wall Thickness (Inches)
20"- 22"	0.344
24"	0.375
28"	0.438
30"	0.469
32"	0.501
34"- 36"	0.532

302.6 BEDDING, HAUNCHING AND INITIAL BACKFILL

The material used for pipe bedding, haunching and initial backfill shall consist of gravel, crushed gravel, or crushed stone conforming to the requirements of Article 1004.01 of the "Standard Specifications for Road and Bridge Construction", prepared by the Illinois Department of Transportation. The gradation shall conform to gradation CA-7 or CA-11 of the Standard Specifications.

302.7 SELECTED GRANULAR BACKFILL

Selected granular backfill, or trench backfill, shall consist of gravel, crushed gravel, or crushed stone conforming to the requirements of Article 1004.01 of the "Standard Specifications for Road and Bridge Construction", prepared by the Illinois Department of Transportation. The gradation shall conform to gradation CA-6 of the Standard Specifications.

303 CONSTRUCTION REQUIREMENTS

303.1 GENERAL REQUIREMENTS

303.1.1 RESPONSIBILITY FOR MATERIALS

The contractor shall be responsible for the acceptability and storage of all materials furnished by him and shall assume responsibility for the replacement of all such material found damaged in shipping or on job site or defective in manufacture. This shall include the furnishing of all material and labor required for the replacement of installed material discovered to be defective prior to the final acceptance of the work.

303.1.2 STORAGE OF PIPING MATERIALS

The interior, as well as all sealing surfaces of all pipe, fittings, and other accessories shall be kept free from dirt and foreign matter. Store pipe bundles on flat surfaces with uniform support. Pipe stored outside and exposed to prolonged periods of sunlight should be covered with canvas or other opaque material. Clear plastic sheets shall not be used. Air circulation shall be provided under covering. Keep gaskets away from oil, grease, electric motors (which produce ozone), excessive heat and direct rays of the sun. Consult the manufacturer for specific storage recommendations.

303.1.3 HANDLING OF PIPING MATERIALS

Piping materials shall be unloaded, hauled and distributed at the site of the project by the contractor. Materials shall at all times be handled properly to prevent damage in accordance with manufacturer's recommendations. Pipe and fittings shall not be thrown, dropped, or dragged. Damaged or defective material on the job site shall be rejected and replaced to the satisfaction of the City Engineer. Methods of construction conducive to the damage of sewer pipe shall be corrected when called to the attention of the contractor. All pipe and fittings shall be examined by the contractor above grade before placement in the trench.

303.2 MANHOLES

303.2.1 PIPE CONNECTIONS

Where a connection is made to an existing manhole, the manhole shall be cored, and a flexible pipe-to-manhole connector installed. The existing manhole bench shall be reworked as required by City Engineer.

Inverts shall be made to conform accurately to the sewer grades with smooth, well rounded junctions and transitions satisfactory to the City Engineer. If the invert is to be poured in place, the sanitary sewer pipe shall be extended through the manhole, the concrete poured and formed, and the pipe then sawed out through the manhole.

303.3 TRENCHING

Trench construction shall be done in accordance with Sections 20 and 31 of the Standard Specifications for Water and Sewer Main Construction in Illinois, except as modified herein.

303.3.1 WIDE TRENCH

Wide trenches are classified as trenches whose width at the top of the pipe is greater than 2 1/2 pipe diameters on each side of the pipe or a total of 6 pipe diameters. Although there is no width of trench beyond which the load on a flexible pipe exceeds the prism load, accepted installation practices usually dictate narrow trench construction. In isolated circumstances it may be more cost effective to use wide trench construction, i.e., in areas where narrow trench walls cannot be maintained. If trench width at the top of a small diameter pipe (4 inch - 10 inch diameter) must exceed 6 pipe diameters, the embedment up to the pipe spring line should be compacted to a point approximately 2 1/2 pipe diameters from each side of the pipe. For large diameter PVC pipe (12 inch - 48 inch diameter) installed in wide trenches, the embedment up to the pipe spring line should be compacted to a point at least one pipe diameter or 2 feet from side of the pipe, whichever is greater.

303.3.2 ROCK SUB-GRADE

Ledge rock, hard pan, cobbles, boulders or stones larger than 1 1/2 inches shall be removed from the trench bottom to permit a minimum bedding thickness of 6 inches.

303.4 PIPE BEDDING AND BACKFILL

Granular pipe bedding and haunching shall be required on all sanitary sewers installed in the City of Naperville. Initial backfill shall be required for all sanitary sewers constructed of PVC or other flexible pipe material.

303.4.1 PIPE BEDDING

Granular pipe bedding shall be provided so that the pipe will be uniformly supported and the entire length of the pipe barrel will have full bearing. No blocking of any kind shall be used to adjust the pipe to grade except when used with embedment concrete. Bedding shall be required for all sewer construction, and shall be of a thickness equal to 1/4 of the outside diameter of the sewer pipe with a maximum thickness of eight inches. Granular pipe bedding shall be a minimum of 4 inches in earth excavation and a minimum of 6 inches in rock excavation.

Where unsuitable material is encountered at the grade established, all such unsuitable soil shall be removed under the pipe and for the width of the trench, and shall be replaced with well compacted bedding material. The size range and resulting high voids ratio of bedding material make it suitable for use to dewater trenches during pipe installation. This permeable characteristic dictates that its use be limited to locations where pipe support will not be lost by migration of fine grained natural material from the trench walls and bottom or migration of other materials into the bedding material. When such migration is possible, the material's minimum size range should be reduced to finer than 1/4 inch and the gradation properly designed to limit the size of the voids.

Bedding materials shall be placed to provide uniform and adequate longitudinal support under the pipe. Bell holes at each joint shall be provided to permit the joint to be assembled properly while maintaining uniform pipe support. When the joint has been made, the void under the bell will be filled with bedding or haunching material.

303.4.2 HAUNCHING

The most important factor affecting pipe performance and deflection is the haunching material and its density. Place and consolidate the material under the pipe haunch to provide adequate side support to the pipe while avoiding both vertical and lateral displacement of the pipe from proper alignment. Place haunching up to the pipe spring line.

303.4.3 INITIAL BACKFILL FOR FLEXIBLE PIPE

Initial backfill begins above the spring line of the pipe and extends to a point 6 inches above the top of the pipe. This material shall be carefully placed so as to completely fill the space around the pipe, in 8 inch layers, loose measurements, and compacted to the satisfaction of the City Engineer.

303.4.4 SELECTED GRANULAR BACKFILL (TRENCH BACKFILL)

The backfill for trenches and excavation made in existing or under proposed pavements where the inner edge of the trench is within 2 feet of the edge of the pavement, curb, gutter, curb and gutter, or sidewalk, shall be made with compacted selected granular material. Selected granular backfill shall be placed in uniform layers not exceeding 6 inches (loose measure) and compacted with mechanical equipment to 95% of the standard proctor density in accordance with the applicable AASHTO or ASTM requirements.

303.4.5 DEPTH OF PIPE COVER

All pipe shall be laid to a minimum depth of 7 feet measured from the proposed ground surface to the top of the pipe, unless specifically allowed otherwise in special circumstances by the City Engineer. If allowed, sanitary sewer and services with ground cover less than 4 feet or more than 25 feet must be constructed of ductile iron class 50 pipe. PVC pipe installed for sewer depths between 20-25 feet shall have a SDR 21 rating. All sanitary sewers and services with less than 4 feet of cover shall have insulation.

303.5 PIPE INSTALLATION

303.5.1 LAYING OF PIPE

Sanitary sewer pipe shall be laid true to line and grade as set forth in Section 31 paragraph 31-1.02 of the "Standard Specifications for Water and Sewer Main Construction in Illinois." Dirt and other foreign material shall be prevented from entering the pipe or pipe joint during handling or laying operations.

Any pipe or fitting that has been installed with dirt or foreign material in it shall be cleaned and re-inspected. At times when pipe laying is not in progress, and at the end of each working day, the open end of the pipe shall be closed with a water tight plug to ensure absolute cleanliness inside the pipe. The City Engineer may request mechanical cleaning (jet flushing) and/or televising if necessary to ensure clean, acceptable pipes, at the contractor's expense.

303.5.2 LAYING OF PIPE ON CURVES

The curvature of sanitary sewers is allowed for sewers 8 inches to 12 inches in diameter. Alignments must follow the general alignment of streets. Only a simple curve design is acceptable. The minimum allowable radius of curvature is 300 feet. Compression type pipe joints are required and manholes are required at the beginning and end of all curves. Maximum joint deflection shall not exceed the manufacturer's recommendations.

303.5.3 INSTALLING PIPE THROUGH CASINGS

This work shall be in conformance with Section 20-2.19 of the Standard Specifications for Water and Sewer Main Construction in Illinois, except as modified herein. Encasements for pipes under highways or railroads shall conform to the requirements of the City of Naperville, or the owner of the highway or railroad. Manufactured non-metallic or non-corrosive casing spacers, adjustable runners, or cradles shall be used to support the pipe in the casing and shall be installed per manufacturer's recommendations. A minimum of two supports shall be used per joint of pipe for lengths up to 12.5 feet, and a minimum of three supports shall be used per joint for lengths greater than 12.5 feet. The annular space shall be filled with pea gravel, low-strength grout, or cellular foam concrete and provisions shall be made so that no voids are left. Contractor shall make arrangements to have a City of Naperville representative witness the annular spacing filling operations.

303.5.4 CUTTING AND BEVELING PIPE

For shorter than standard pipe lengths, field cuts may be made with either hand or mechanical saws or plastic pipe cutters. Ends shall be cut square and perpendicular to the pipe axis. Spigots shall have burrs removed and ends smoothly beveled by a mechanical bevel or by hand with a rasp or file. Field spigots shall be stop-marked with felt tip marker or wax crayon for the proper length of assembly insertion. The angle and depth of field bevels and lengths to stop-marks shall be comparable to factory pipe spigots.

303.5.5 ASSEMBLY OF JOINTS

Assemble all joints in accordance with recommendations of the manufacturer. If a lubricant is required to facilitate assembly it shall have no detrimental effect on the gasket or on the pipe when subjected to prolonged exposure. Proper jointing may be verified by rotation of the spigot by hand or with a strap wrench. If unusual joining resistance is encountered or if the insertion mark does not reach the flush position, disassemble the joint, inspect for damage, re-clean the joint components and repeat the assembly steps. Note that fitting bells may permit less insertion depth than pipe bells (NOTE: When mechanical equipment is used to assemble joints, care should be taken to prevent over insertion.)

303.5.6 BUILDING SERVICES

When main line bedding, haunching, initial and final backfill must be disturbed to install fittings and service lines, the contractor is directly responsible to ensure that the bedding, haunching, initial and final backfill with appropriate compaction are restored properly to eliminate the possibility of deflection or movement causing future pipe failure.

303.5.7 PIPE CAPS AND PLUGS

All caps and plugs shall be braced, staked, anchored, wired or otherwise secured to the pipe to prevent leakage under the maximum anticipated thrust from internal abnormal operating conditions or test pressures from water or air.

303.6 BRANCH FITTINGS

Fittings for service branches in new construction shall be molded for 6 inch and 8 inch pipe and fabricated for 10 inch to 16 inch diameter with all gasketed connections. Clay/plastic pipe connections must be watertight. The contractor will be permitted to use fittings which include factory molded saddles and tees with alignment rings, and factory molded wyes. When connecting to an existing sewer main by means other than an existing wye or tee, one of the following methods shall be used:

- a) For PVC existing lines only, a sewer tap into the existing main shall be allowed. This would include a circular saw-cut of the sewer main by proper tools ("Shewer Tap" machine or similar) and proper installation of hub-wye saddle or hub-tee saddle. Holes for wye saddles shall be laid out with a template and shall be de-burred and carefully beveled where required to provide a smooth hole shaped to conform to the fitting.
- b) A typical connection would involve a PVC "T" fitting, another 1' (or more) extension of PVC pipe, depending on location of existing joint, the non-shear coupling and the existing clay or PVC pipe. With pipe cutter or appropriate equipment, neatly and accurately cut out desired length of pipe for insertion of proper fitting, using non-shear reinforced banded style repair coupling with 300 series stainless steel shear ring as manufactured Fernco, Inc. or Mission Rubber Company, Inc., or approved equal, connect the sewer pipes and maintain matching flow line elevations. All couplings shall bear the manufacturer's identifying mark and size.

The contractor shall provide details of direct connections to City interceptors greater than 18 inches in diameter and show construction procedure for protecting City structures.

All proposed bypass pumping of sanitary flow shall be approved by Department of Public Utilities prior to performing this work.

304 INSPECTION AND TESTING

All projects shall be inspected and tested upon completion of installation. The City Engineer will designate the locations of tests and extent of the system to be tested, and extent of recording test results. Equipment for performing tests and making measurements shall be furnished by the contractor. Sections of sewer which fail to pass the tests shall have defects located and repaired or replaced and be retested until within the specified allowance

304.1 MANHOLES

All manholes shall be thoroughly cleaned of dirt and debris and all visible leakage eliminated before final inspection and acceptance.

304.1.1 VACUUM TESTING OF SANITARY MANHOLES

All manholes shall be tested for leakage by vacuum testing. A vacuum of 10 inches Hg shall be placed on the manhole and the time shall be measured for the vacuum to drop to 9 inches Hg. The vacuum shall not drop below 9 inch Hg for the time indicated for each size of manhole as shown in Table 300-2.

**TABLE 300-2
REQUIREMENTS FOR MANHOLE VACUUM TESTING**

Manhole Diameter (inches)	Max. time for 9" Drop (seconds)
48	60
60	75
72	90
84	105

Any manholes that fail the test shall be sealed and re-tested until acceptable. The testing shall be done after backfilling. Leaks found shall be fixed externally unless approved by City Engineer. The manhole frame and adjusting rings shall be in place at finished grade prior to testing.

304.2 FLEXIBLE PIPE

Prior to other tests all sanitary sewer pipes shall be cleaned and inspected for major defects. Pre-cleaning by appropriately sized sewer cleaning ball or by high velocity jet or other method shall be performed. Any debris, grit, etc. shall be removed and shall not be allowed to enter the existing system.

304.2.1 VISUAL TEST

The City of Naperville may require that sewer lines be inspected visually to verify accuracy of alignment and freedom from debris and obstructions. The percentage of sewer lines inspected will be designated by the City Engineer. The full diameter of the pipe for straight alignments shall be visible when viewed between consecutive manholes. The method of test shall be either photography or closed circuit television, unless a specific method is required by the special provisions and approved by the City Engineer.

304.2.2 DEFLECTION TESTING

A mandrel test is required by the City of Naperville. The City Engineer shall randomly select portions of the project to be deflection tested. Such portions shall consist of the manhole intervals for the initial sewer construction up to 1,200 linear feet and not less than 20% of the remainder of the sewer project. The City of Naperville reserves the right to test more or less pipe if considered appropriate by the City Engineer.

The 5% deflection test for pipe sizes 6 inches to 18 inches in diameter is to be run using a nine-arm mandrel having a diameter equal to 95% of the inside diameter of the pipe as established in ASTM D-2241-96b. Table 300-3 was developed for various pipe sizes using the equations outlined in Section 31-1.11C of the Standard Specifications for Water and Sewer Main Construction in Illinois.

**TABLE 300-3
REQUIRED MANDREL SIZE FOR SDR 26 PIPE
(ASTM D2241)**

Nominal Pipe Size, Inches	Average Inside Diameter	Required Mandrel Size, Inches
6	6.08	5.68
8	7.92	7.38
10	9.87	9.23
12	11.71	10.98
14	12.86	12.02
16	14.70	13.65

TIME OF TESTING

The individual lines to be tested shall be tested no sooner than 30 days after they have been installed by the contractor. During the first year of implementation, additional testing may be performed by the City of Naperville.

SEQUENCE OF TESTING

Wherever possible and practical, the testing shall initiate at the downstream lines and proceed towards the upstream lines.

TESTING OF ENTIRE PROJECT

In the event that the deflection exceeds the 5% limit in 10% or more of the manhole intervals tested, the total sewer project shall be tested.

RETEST OF FAILED SECTIONS

Where deflection is found to be in excess of 5% of the base inside diameter, the contractor shall excavate to the point of excess deflection and carefully compact around the point where excess deflection was found. The line shall then be retested for deflection. However, if the

deflected pipe fails to return to the original size (inside diameter) after the initial testing, the affected segment shall be replaced.

304.2.3 LEAKAGE TEST

Methods of test which are suitable for various conditions are low pressure air exfiltration or water exfiltration. Explicit instructions for the following methods of test will be supplied by the project design engineer. Plugs, caps, and branch connections must be secured against blow-off during leakage test.

AIR TESTING SAFETY

The contractor is required to follow OSHA rules for trench safety and confined space requirements.

PLUG RESTRAINT

All plugs shall be installed and braced in such a way that blowouts are prevented. Every plug shall be positively braced against the manhole walls, and no one shall be allowed in the manhole adjoining a line being tested so long as pressure is maintained in the line.

RELIEF VALVE

All pressurizing equipment used for low-pressure air testing shall include a regulator or relief valve set no higher than 9 psig to avoid over-pressurizing and displacing temporary or permanent plugs. As an added safety precaution pressure in the test section should be continuously monitored to make certain that it does not at any time exceed 9 psig.

PLUG DESIGN

Either mechanical or pneumatic plugs may be used. All plugs shall be designed to resist internal testing pressures without the aid of external bracing or blocking. However, the contractor shall internally restrain or externally brace the plugs to the manhole wall as an added safety precaution throughout the test.

SINGULAR CONTROL PANEL

To facilitate test verification by the City Engineer, all air used shall pass through a single, above ground control panel.

EQUIPMENT CONTROLS

The above ground air control equipment shall include a shut-off valve, pressure regulating valve, pressure relief valve, input pressure gauge, and a continuous monitoring pressure gauge having a pressure range from 0 to at least 10 psi. The continuous monitoring gauge shall be no less than 4 inches in diameter with minimum divisions of 0.10 psi and an accuracy of 0.04 psi.

SEPARATE HOSES

Two separate hoses shall be used to (1) connect the control panel to the sealed line for inducing low-pressure air, and (2) a separate hose connection for constant monitoring of air

pressure build-up in the line. This requirement greatly diminishes any chance for over-pressurizing the line.

PNEUMATIC PLUGS

If pneumatic plugs are utilized, a separate hose shall also be required to inflate the pneumatic plugs from the above ground control panel.

LINE PREPARATION - LATERALS, STUBS AND FITTINGS

During sewer construction, all service laterals, stubs, and fittings into the sewer test section shall be properly capped or plugged so as not to allow for air loss that could cause an erroneous air test result. It may be necessary and is always advisable to restrain gasketed caps, plugs, or short pipe lengths with bracing stakes, clamps and tie-rods, or wire harnesses over the pipe bells.

PLUG INSTALLATION AND TESTING

After a manhole to manhole reach of pipe has been back-filled to final grade and prepared for testing, the plugs shall be placed in the line at each manhole and secured.

It is advisable to seal test all plugs before use. Seal testing may be accomplished by laying one length of pipe on the ground and sealing it at both ends with the plugs to be checked. The sealed pipe should be pressurized to 9 psig. No persons shall be allowed in the alignment of the pipe during plug testing.

It is required to plug the upstream end of the line first to prevent any upstream water from collecting in the test line.

When plugs are being placed, the pipe adjacent to the manhole shall be visually inspected to detect any evidence of shear in the pipe due to differential settlement between the pipe and the manhole.

LINE PRESSURIZATION

Low pressure air shall be slowly introduced into the sealed line until the internal air pressure reaches 4.0 psig greater than the average back pressure of any ground water above the pipe, but not greater than 9.0 psig. If ground water is present, refer to 'Determination of Ground-Water Elevation and Air Pressure Adjustment'.

PRESSURE STABILIZATION

After a constant pressure of 4.0 psig (greater than the average ground water back pressure), is reached, the air supply shall be throttled to maintain that internal pressure for at least 4 minutes. This time permits the temperature of the entering air to equalize with the temperature of the pipe wall.

TIMING PRESSURE LOSS

When temperatures have been equalized and the pressure stabilized at 4.0 psig (greater than the average ground water back pressure), the air hose from the control panel to the air supply

shall be shut off or disconnected. The continuous monitoring pressure gauge shall then be observed while the pressure is decreased to no less than 3.5 psig (greater than the average back pressure of any ground water over the pipe). At a reading of 3.5 psig, or any convenient observed pressure reading between 3.5 psig and 4.0 psig (greater than the average ground water back pressure), timing shall commence with a stop watch or other timing device that is at least 99.8% accurate.

DETERMINATION OF LINE ACCEPTANCE

If the time shown in Table 2, for the designated pipe size length (which includes main line sewers and laterals), is achieved before the air pressure drops 0.5 psig; the section undergoing test shall have passed and shall be presumed to be free of defects. The test may be discontinued once the prescribed time has elapsed even though the 0.5 psig drop has not occurred.

DETERMINATION OF LINE FAILURE

If the pressure drops 0.5 psig before the appropriate time shown in Table 3 has elapsed, the air loss rate shall be considered excessive and the section of pipe has failed the test.

LINE REPAIR OR REPLACEMENT

If the section fails to meet these requirements, the contractor shall determine at his own expense, the source or sources of leakage and he shall repair or replace all defective materials and/or workmanship to the satisfaction of the City Engineer. The extent and type of repair which may be allowed, as well as the results, shall be subject to the approval of the City Engineer. The completed pipe installation shall then be retested and required to meet the requirements of this test.

304.2.4 LEAKAGE TESTING – ADJUSTMENTS FOR GROUND WATER

The requirements of this section shall only apply where ground water is known to exist or is anticipated above the sewer line to be tested.

AIR PRESSURE ADJUSTMENT

The air pressure correction, which must be added to the 3.5 psig normal testing starting pressure, shall be calculated by dividing the average vertical height, in feet of ground water above the invert of the sewer pipe to be tested, by 2.31. The result gives the air pressure correction in pounds per square inch to be added. (For example, if the average vertical height of ground water above the pipe invert is 2.8 feet the additional air pressure required would equal 2.8 divided by 2.31 or 1.2 psig. This would require a minimum starting pressure of 3.5 psig plus 1.2 psig or 4.7 psig.) The allowable pressure drop of 0.5 psig and the timing in Table 300-4 are not affected and shall remain the same.

MAXIMUM TEST PRESSURE

In no case should one starting test pressure exceed 9.0 psig. If the average vertical height of ground water above the pipe invert is more than 12.7 feet, the section so submerged may be tested using 9.0 psig as the starting test pressure.

SPECIFIED TIME TABLES

To facilitate the proper use of this required practice for air testing, Table 300-4 is provided. Table 300-4 contains specified minimum times required for a 0.5 psig pressure drop from a starting pressure of at least 3.5 psig greater than the average back pressure of any ground water above the pipe's invert.

TABLE 300-4

**SPECIFIED TIME REQUIRED FOR A 0.5 PSIG PRESSURE DROP
FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q = 0.0015**

(1) Pipe Dia. (in)	(2) Min. Time min:sec	(3) Length For Min. Time (ft)	(4) Time For Longer Length (sec)	Specification Time for Length (L) Shown (min:sec)								
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft	500 ft
4	1:53	597	0.190 L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	0.427 L	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12	3:34
8	3:47	298	0.760 L	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42	6:20
10	4:43	239	1.187 L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54	9:54
12	5:40	199	1.709 L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50	14:15
15	7:05	159	2.671 L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02	22:16
18	8:30	133	3.846 L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51	32:03
21	9:55	114	5.235 L	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16	43:38
24	11:20	99	6.837 L	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17	56:59
27	12:45	88	8.653 L	14:25	21:38	28:51	36:04	43:16	50:30	57:42	64:54	72:07
30	14:10	80	10.683 L	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07	89:02
33	15:35	72	12.926 L	21:33	32:19	43:56	53:52	64:38	75:24	86:10	96:57	107:43
36	17:00	66	15.384 L	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23	128:12

390 STANDARD DETAILS

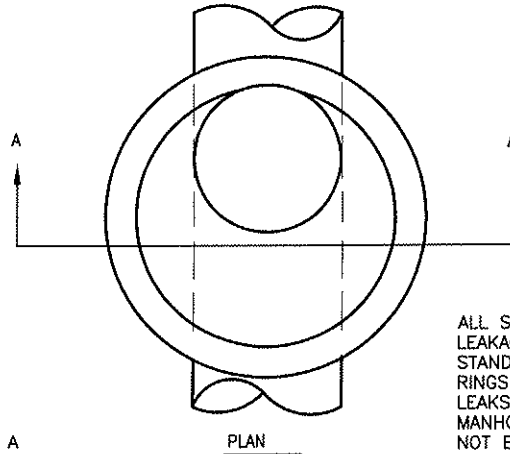
- 390.01 Sanitary Sewer Manhole
- 390.02 Sanitary Manhole – Exterior Drop Connection
- 390.03 Sanitary Manhole – Interior Drop Connection
- 390.04 Sanitary Manhole – Drop Connection to Ex. Manhole
- 390.05 Sanitary Manhole – Dog House Connection
- 390.06 Sanitary Manhole - Frame and Cover

- 390.10 Trench Section for PVC Pipe

- 390.20 Riser for Service Lateral
- 390.21 Sanitary Sewer Service Connection
- 390.22 Sanitary Sewer Pipe Insulation

390.99 COMMON NAMES

All standard details in this section may be referred to by a common name in associated construction documents. The common name shall be “SANITARY xx” where the xx is the section of the detail number to the right of the decimal point. For instance, *Detail #390.01 Sanitary Sewer Manhole* may also be referred to as “SANITARY 1”.



Inside MANHOLE DIAMETER.	48"	60"
Pipe DIAMETER.	≤21"	>21"
Wall Thickness	5"	6"
Ecc. Cone Sec.(L)	2'-6"	3'-9"
MANHOLE DEPTH	≤12'	>12'
t	8"	10"

ALL SANITARY MANHOLES SHALL BE TESTED FOR LEAKAGE BY VACUUM TESTING PER CITY STANDARDS. THE MANHOLE FRAME AND ADJUSTING RINGS SHALL BE IN PLACE WHEN TESTING. ANY LEAKS SHALL BE REPAIRED FROM EXTERIOR OF MANHOLE - PATCHING INSIDE OF MANHOLE SHALL NOT BE ACCEPTABLE.

AT EACH JOINT, APPLY A CONTINUOUS LAYER OF NON-HARDENING PREFORMED BITUMINOUS MASTIC MATERIAL, CONSEAL CS-102B, OR APPROVED EQUAL.

EXTERNAL CHIMNEY SEAL (OPTIONAL)

12" MAX. PRECAST CONC. ADJUSTING RINGS (2 RINGS MAX. NO MORE THAN ONE 2" ADJUSTING RING SHALL BE USED)

ECCENTRIC CONE SECTION

STEPS SHALL BE COPOLYMER POLYPROPYLENE REINFORCED WITH $\frac{1}{8}$ INCH A615/615M-05A (OR LATEST EDITION) GRADE 60 STEEL REINFORCEMENT, MEETING OR EXCEEDING ASTM C478-05 AND OSHA STANDARDS.

CA-6 TRENCH BACKFILL REQUIRED AROUND MANHOLE IN PAVED AREAS AND UNDER SIDEWALKS, MANHOLE TO ROADWAY SUBGRADE ELEVATION

RUBBER BOOT CONFORMING TO ASTM C923-02 OR LATEST REVISION (KOR-N-SEAL OR APPROVED EQUAL)

POURED CONCRETE FILLET TO TOP OF PIPE 2% SLOPE (TYP.)

PROVIDE CONCRETE FILLET FOR ALL SANITARY MANHOLE INVERTS

PRECAST REINFORCED CONCRETE MANHOLE BOTTOM WITH INTEGRAL SIDEWALL

6" CA11 AGGREGATE

SECTION A-A

PRECAST REINFORCED CONC. SECTIONS

STEPS
16"
O.C. MAX.

8"
24" DIA.

L



City of Naperville
**STANDARD
DETAIL**

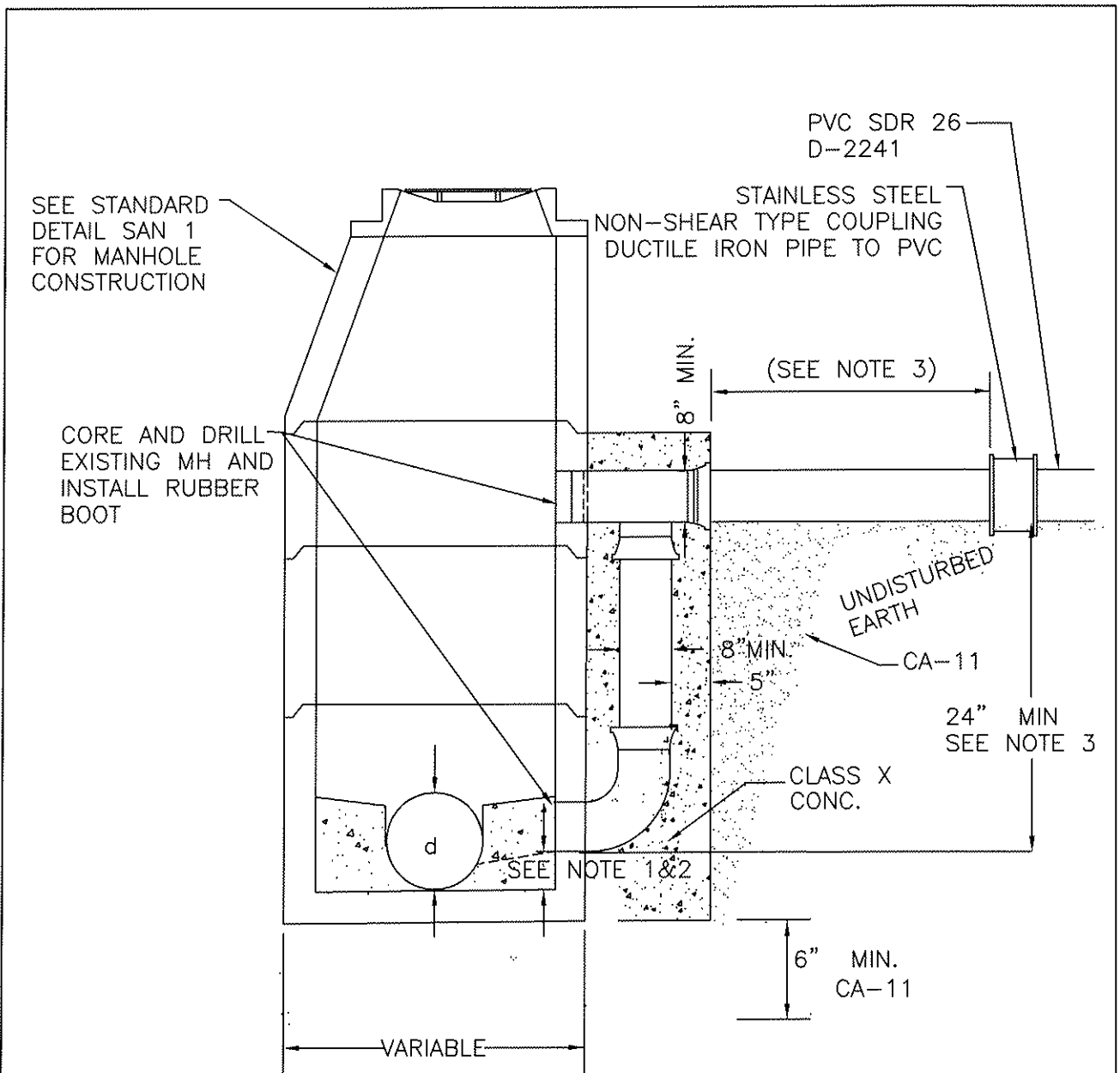
SANITARY SEWER MANHOLE

REVISED: 01/01/2013

SHEET 1 OF 1

SANITARY 1

390.01



1. NOTE DROP INVERT TO BE $\frac{1}{4}$ " TO $\frac{1}{2}$ "
d= DIAMETER OF LOWER EXISTING PIPE
2. CONCRETE BENCH TO PROVIDE SMOOTH TRANSITION
3. PVC SDR 26, ASTM 2241 MAY BE USED FOR DROPS 2' TO 4'; FOR DROPS GREATER THAN 4' USE DUCTILE IRON PIPE SCH 50 MIN ONE FULL LENGTH.



City of Naperville
**STANDARD
DETAIL**

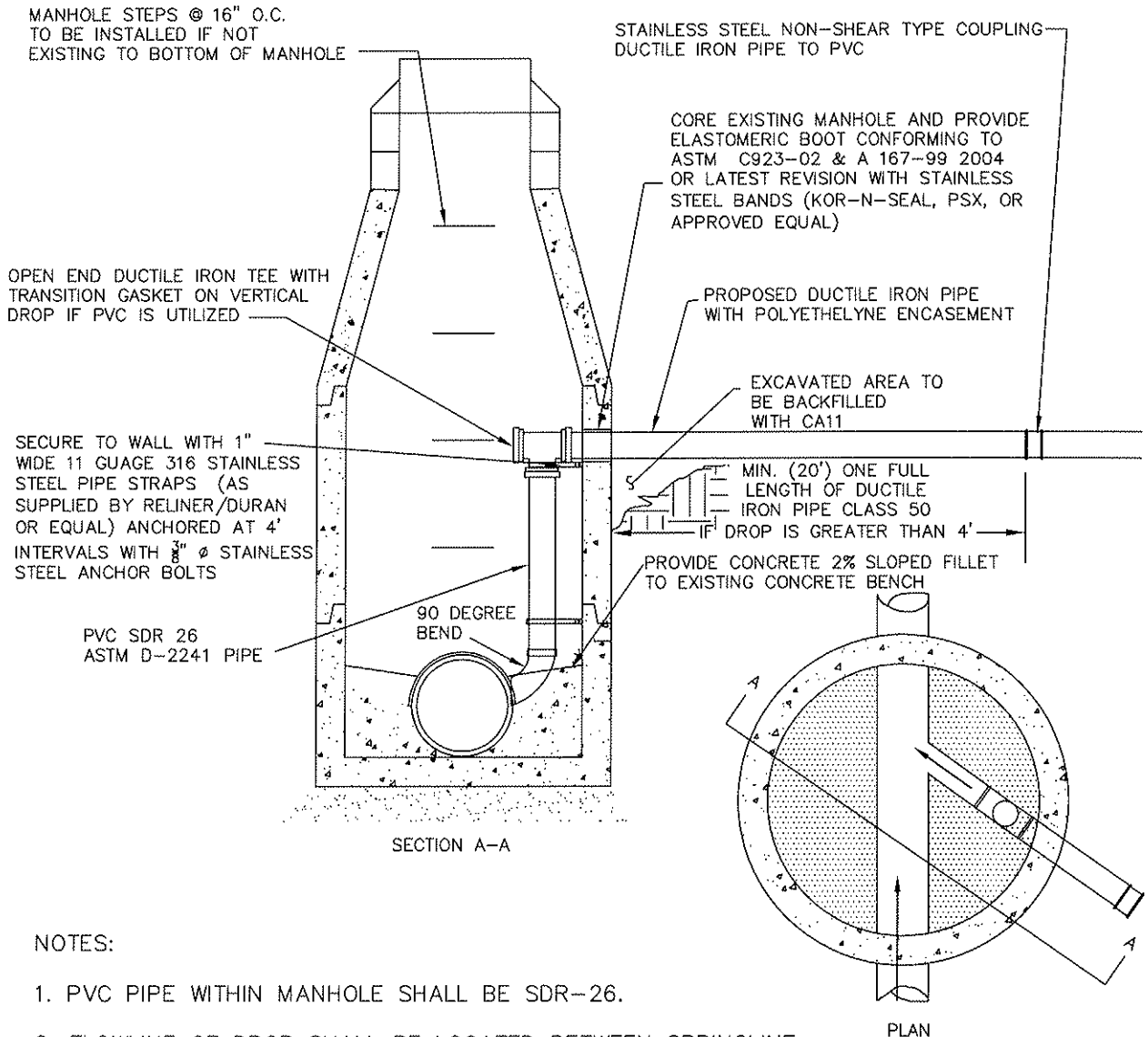
**SANITARY MANHOLE - EXTERIOR
DROP CONNECTION**

REVISED: 01/01/2013

SHEET 1 OF 1

SANITARY 2

390.02



NOTES:

1. PVC PIPE WITHIN MANHOLE SHALL BE SDR-26.
2. FLOWLINE OF DROP SHALL BE LOCATED BETWEEN SPRINGLINE AND TOP OF SEWER MAIN.
3. EXISTING FLOW THROUGH MANHOLE SHALL BE UNOBSTRUCTED DURING CONSTRUCTION OR BYPASS PUMPED PER CITY APPROVAL.
4. ALL HARDWARE WITHIN MANHOLE SHALL BE 316 STAINLESS STEEL
5. ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH CITY OF NAPERVILLE DESIGN STANDARDS. INTERIOR DROP AND PROPOSED ELEVATIONS MUST BE APPROVED BY DEPARTMENT OF PUBLIC UTILITIES.
6. FLEXIBLE COUPLING CONNECTING DUCTILE IRON PIPE TO PVC PIPE SHALL BE A SHEAR RING TYPE COUPLING AS MANUFACTURED BY FERNCO, SERIES 1056R OR APPROVED EQUAL.



City of Naperville
**STANDARD
DETAIL**

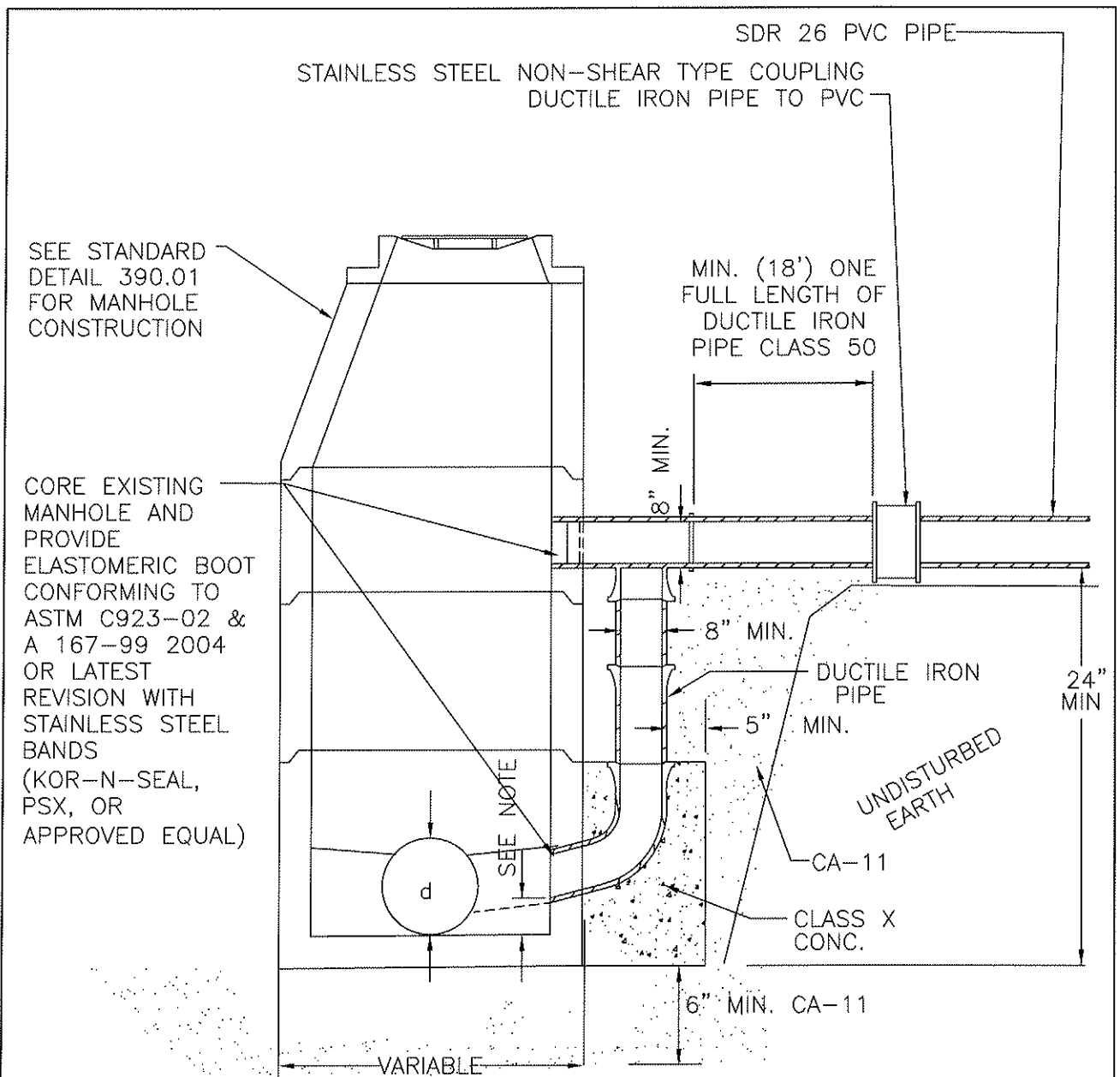
**SANITARY MANHOLE - INTERIOR
DROP CONNECTION**

REVISED: 01/01/2013

SHEET 1 OF 1

SANITARY 3

390.03



NOTE:

1. INVERT OF DROP CONNECTION TO BE $1/4$ TO $1/2$
OF "d" UNLESS OTHERWISE NOTED ON PLANS (d=
DIAMETER OF LOWER EXISTING PIPE)

2. EXISTING CONCRETE BENCH REWORKED TO PROVIDE
SMOOTH TRANSITION.

3. ALL DUCTILE IRON PIPE TO BE CONCRETE ENCASED.



City of Naperville
**STANDARD
DETAIL**

**SANITARY MANHOLE - DROP
CONNECTION TO EX MANHOLE**

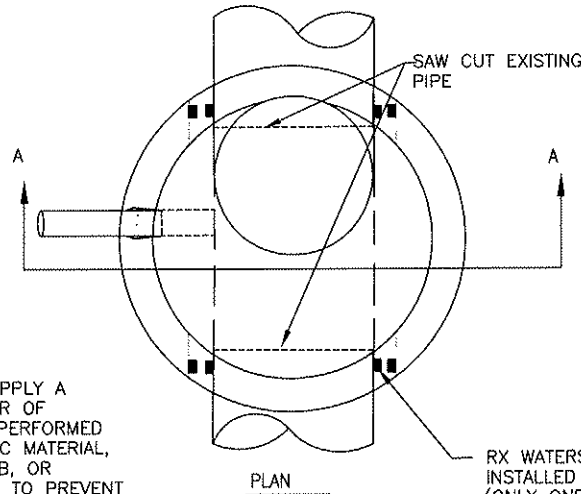
REVISED: 01/01/2013

SHEET 1 OF 1

SANITARY 4

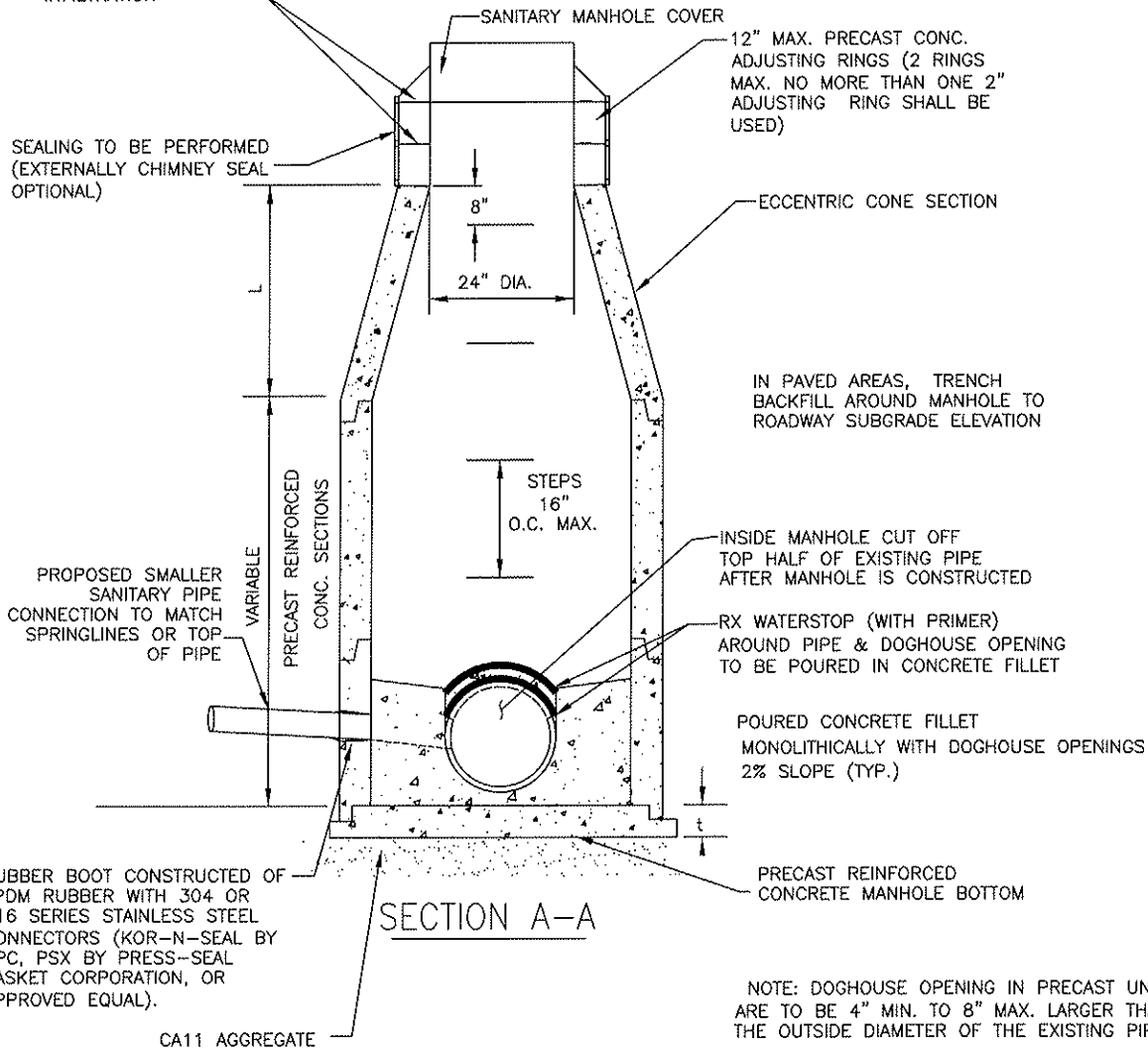
390.04

INSIDE MANHOLE DIAMETER.	48"	60"
PIPE DIAMETER.	≤21"	>21"
WALL THICKNESS	5"	6"
ECC. CONE SEC.(L)	2'-6"	3'-9"
MANHOLE DEPTH	≤12'	>12'
T	8"	10"



AT EACH JOINT, APPLY A CONTINUOUS LAYER OF NON-HARDENING PERFORMED BITUMINOUS MASTIC MATERIAL, CONCEAL CS-102B, OR APPROVED EQUAL, TO PREVENT INFILTRATION

RX WATERSTOP OR APPROVED EQUAL INSTALLED PER MANUFACTURERS RECOMMENDATIONS. (ONLY ONE SIDE SHOWN FOR CLARITY.)



NOTE: DOGHOUSE OPENING IN PRECAST UNIT ARE TO BE 4" MIN. TO 8" MAX. LARGER THAN THE OUTSIDE DIAMETER OF THE EXISTING PIPE.



City of Naperville
**STANDARD
DETAIL**

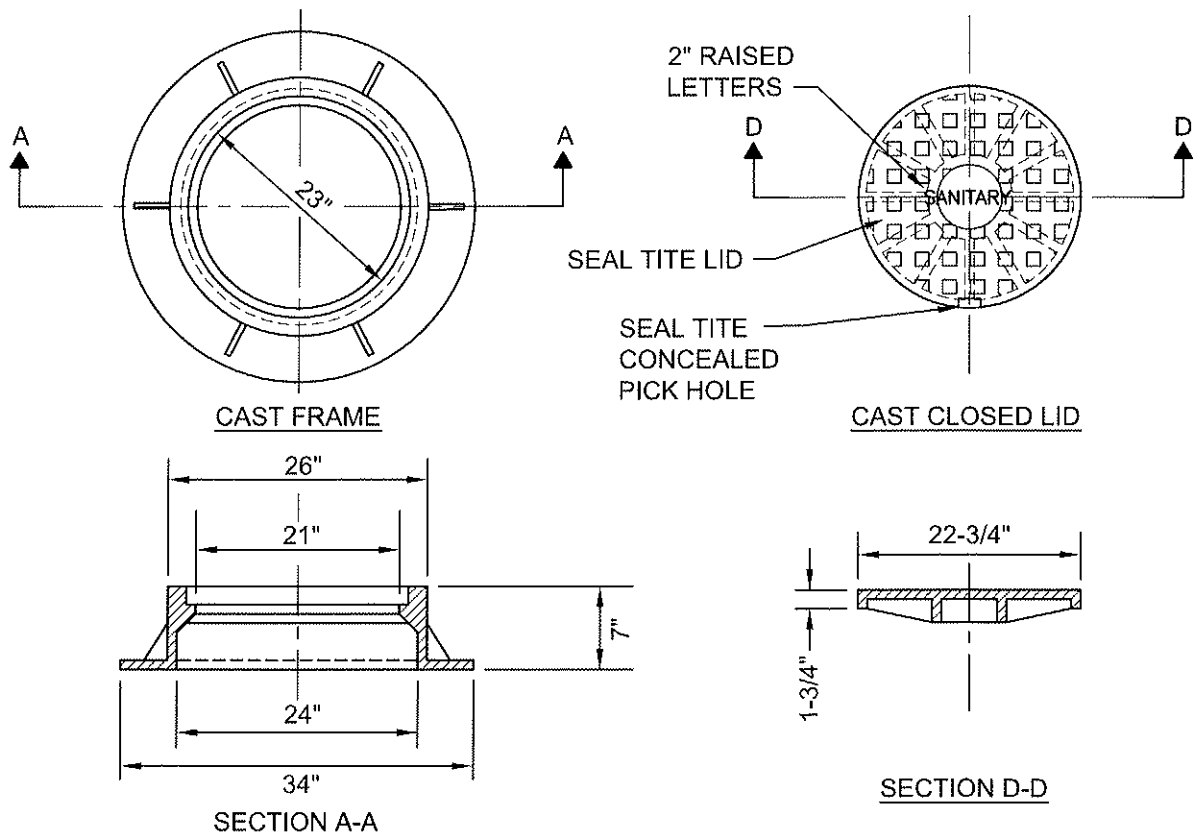
**SANITARY MANHOLE - DOG
HOUSE CONNECTION**

REVISED: 01/01/2013

SHEET 1 OF 1

SANITARY 5

390.05



NOTES:

- 1) DUCTILE IRON SHALL BE GRADE 65-45-12 AND SHALL BE TESTED IN ACCORDANCE WITH FEDERAL SPECIFICATIONS.
- 2) ALL FRAMES AND COVERS SHALL HAVE MACHINED HORIZONTAL AND VERTICAL BEARING SURFACES. PICK HOLES SHALL NOT CREATE OPENINGS IN THE COVER.
- 3) THE MANHOLE COVERS SHALL HAVE 2" RAISED LETTERS AS SHOWN.
- 4) ALTERNATIVE TO DUCTILE IRON LID, GREY IRON CL 35 LID MAY BE USED.
- 5) CASTINGS ARE SHALL BE EAST JORDAN 1022-Z3; NEENAH R-1772 OR APPROVED EQUAL.
- 6) WATERPROOF, BOLTDOWN FRAME AND COVER SHALL BE USED IN FLOOD PLAIN AREA, AND AS NOTED ON THE PLANS. NEENAH R-1916-F1, EAST JORDAN IRON WORKS 1022-Z1PT OR APPROVED EQUAL.
7. LIDS AND FRAMES TO MEET ASSHTO M306 PROOF LOADING SPECIFICATIONS



City of Naperville
**STANDARD
DETAIL**

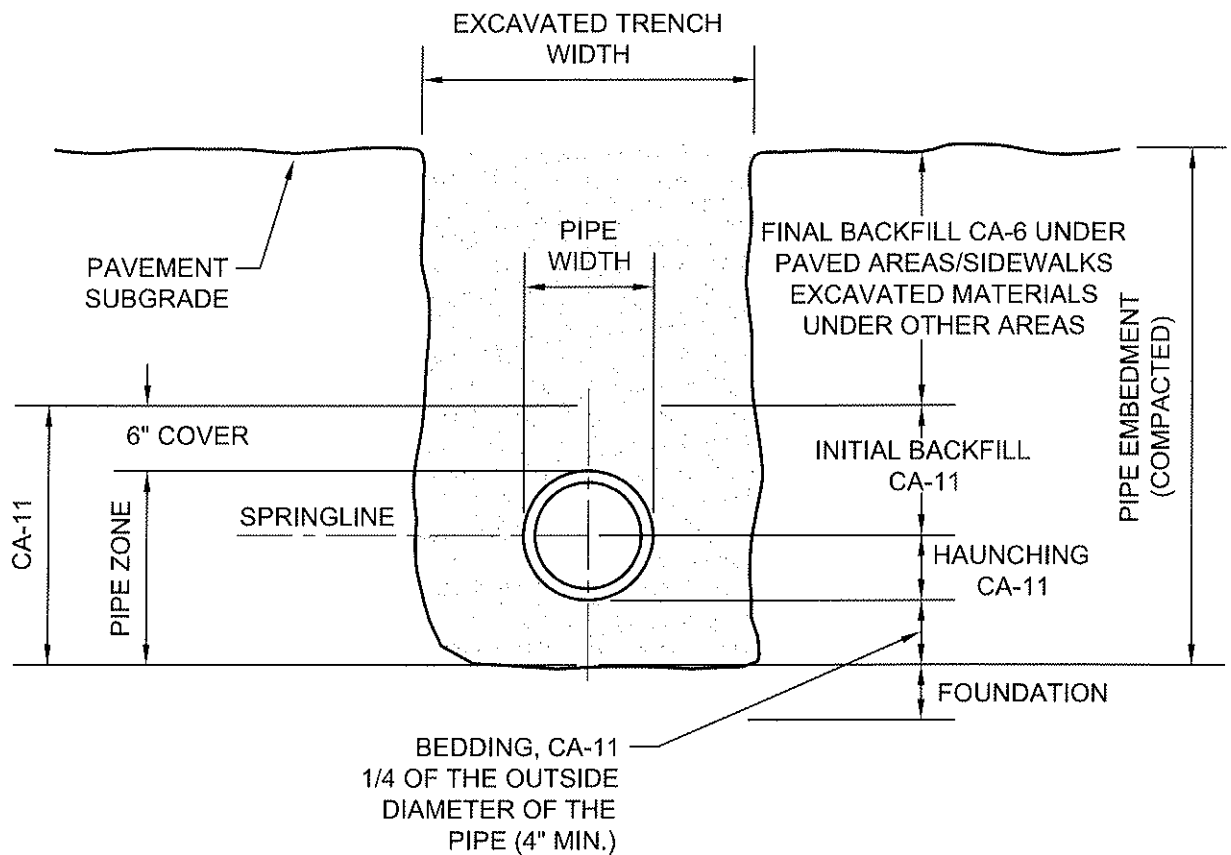
**SANITARY MANHOLE - FRAME &
COVER**

REVISED: 01/01/2013

SHEET 1 OF 1

SANITARY 6

390.06



NOTES:

1. IN PAVED AREAS, ALL TRENCHES MUST BE COMPACTED IN CONFORMANCE WITH SECTION 550.07 OF THE IDOT STANDARD SPECIFICATIONS FOR ROAD & BRIDGE CONSTRUCTION.
2. IF FOUNDATION IS UNSUITABLE TO BED PIPE, UNDERCUTS MAY BE REQUIRED AS DIRECTED BY THE ENGINEER.



City of Naperville
**STANDARD
DETAIL**

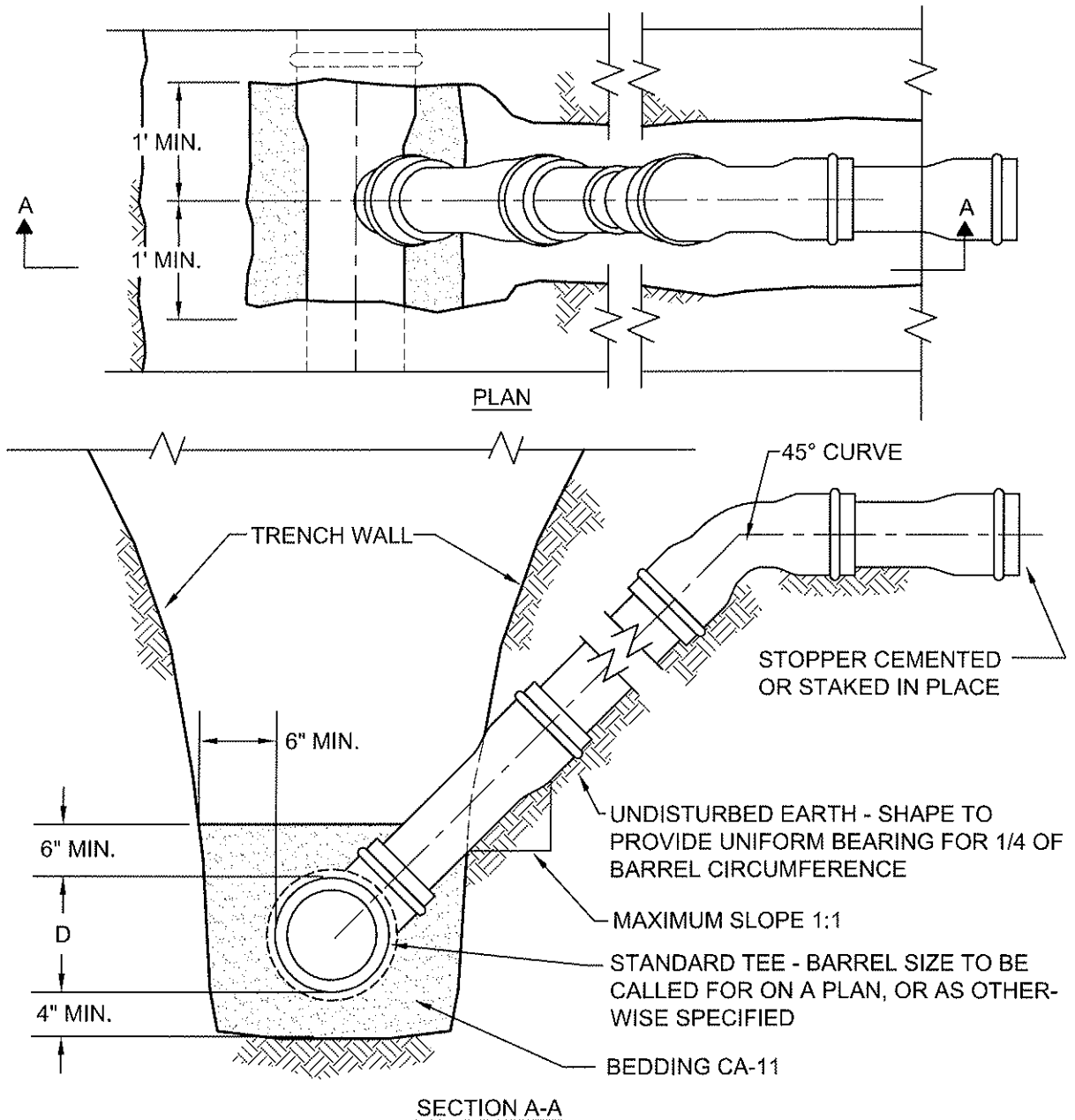
TRENCH SECTION FOR PVC PIPE

REVISED: 01/01/2013

SHEET 1 OF 1

SANITARY 10

390.10



1. THE OPEN ENDS SHALL BE PROTECTED FROM DEBRIS AND GROUNDWATER ENTERING THE LATERAL WITH AN APPROVED PLUG.
2. MAXIMUM SLOPE SHALL BE LESS THAN 1:1 WHEN IT IS NECESSARY TO SECURE BEDDING IN UNDISTURBED EARTH.
3. WHEN A SERVICE CONNECTION IS TAPPED INTO PVC MAIN, THEN A SEWER SADDLE SHALL BE USED. GENECO TYPE "SEALTITE" OR APPROVED EQUAL. BANDS, NUTS AND BOLTS MUST BE 304 STAINLESS STEEL.
4. SDR 26 PVC PIPE MEETING REQUIREMENTS OF ASTM D-2241-05 AND JOINTS CONFORMING TO ASTM D-3139-98(2005) OR LATEST EDITIONS.



City of Naperville
**STANDARD
DETAIL**

RISE FOR SERVICE LATERAL

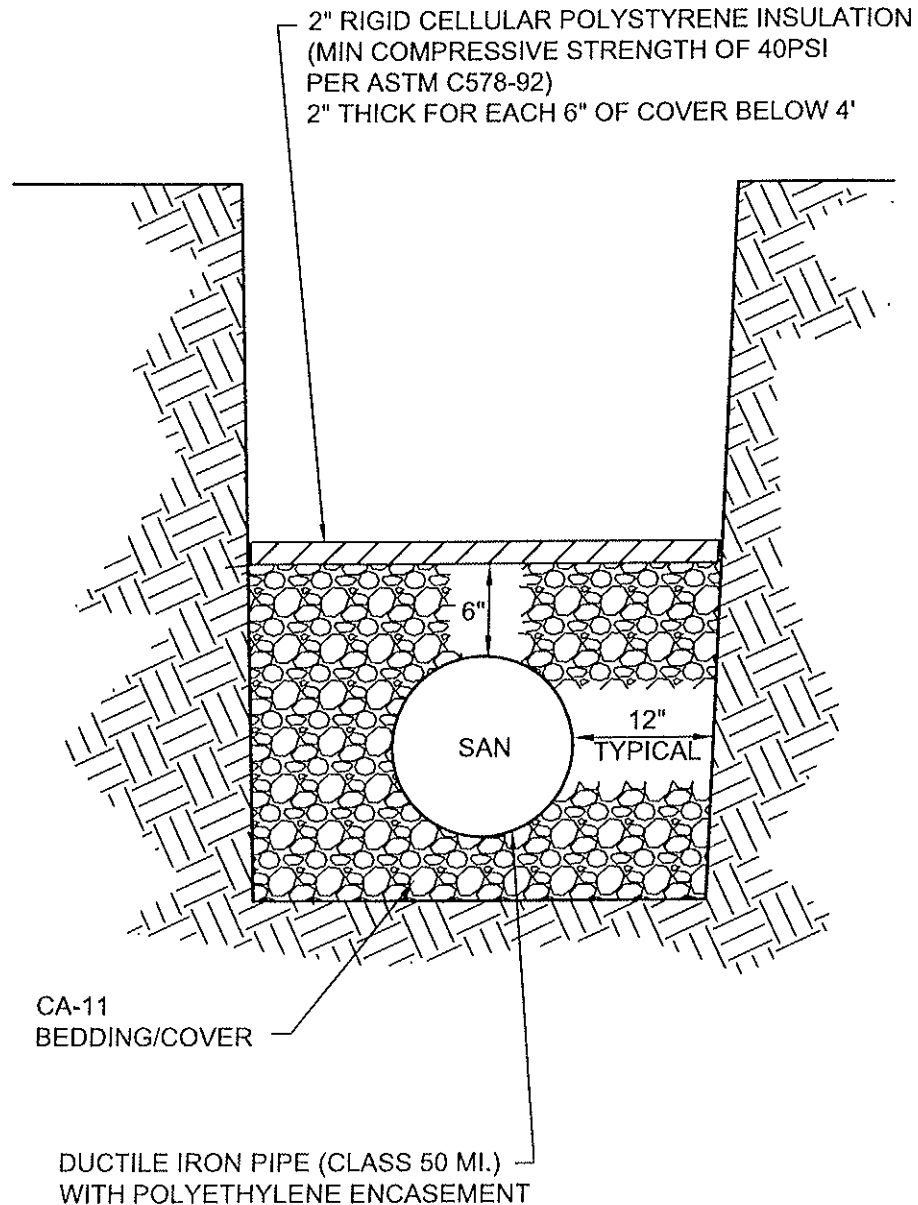
REVISED: 01/01/2013

SHEET 1 OF 1

SANITARY 20

390.20

THE INSTALLATION OF THIS APPLICATION MUST BE APPROVED
IN WRITING BY THE DEPARTMENT OF PUBLIC UTILITIES WATER
CIVIL ENVIRONMENTAL ENGINEERING DIVISION



City of Naperville
**STANDARD
DETAIL**

**SANITARY SEWER PIPE
INSULATION**

REVISED: 01/01/2013

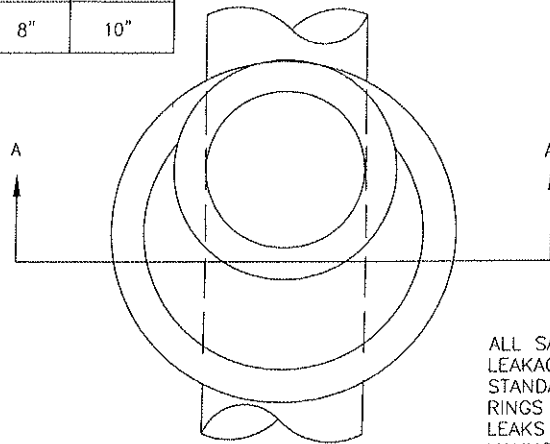
SHEET 1 OF 1

SANITARY 22

390.22

MANHOLE DEPTH	≤ 12'	> 12'
t	8"	10"

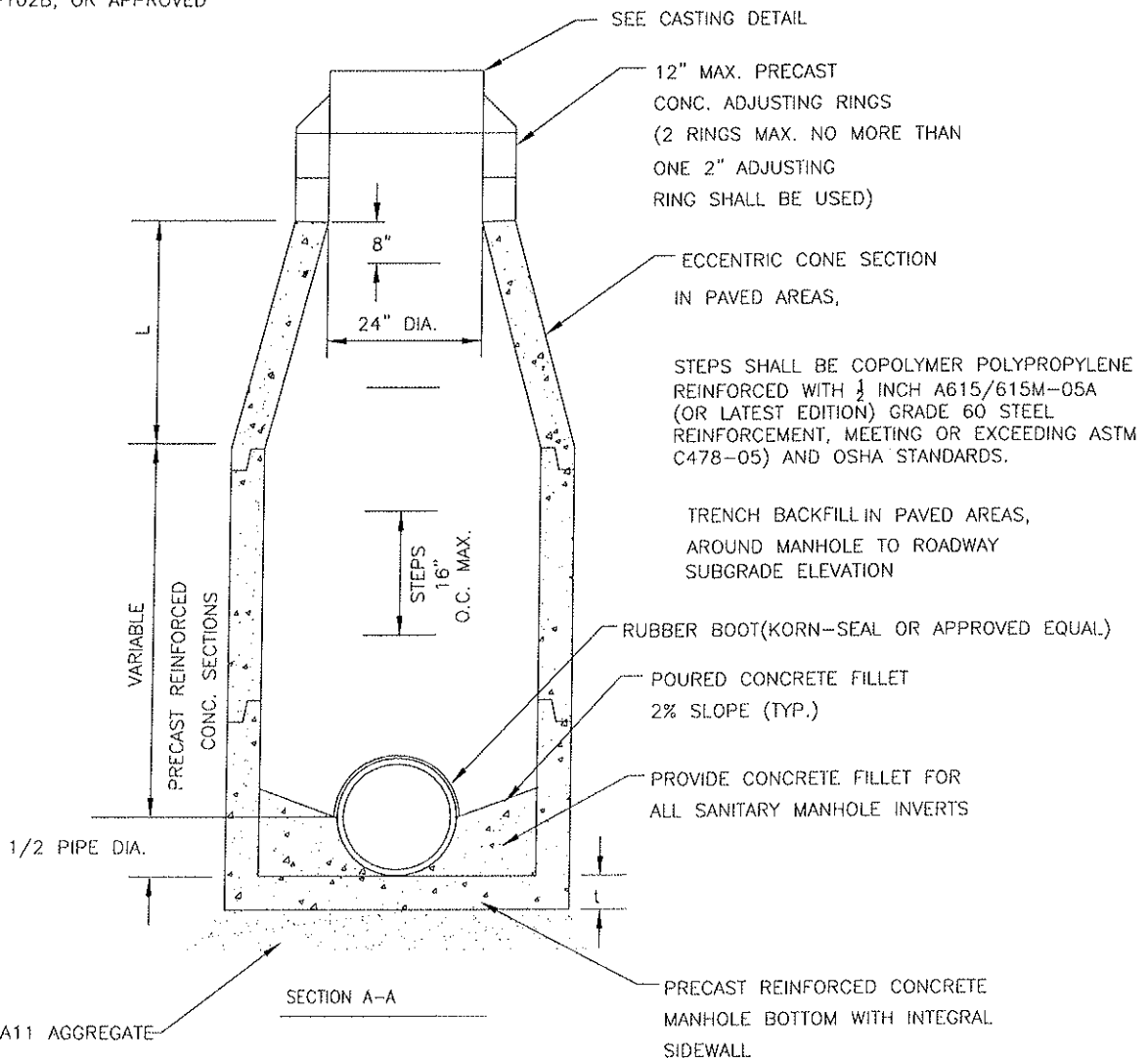
Inside M.H. Dia.	48"	60"
Pipe Dia.	≤ 21"	> 21"
Wall Thickness	5"	6"
Ecc. Cone Sec.(L)	2'-6"	3'-9"



PLAN

ALL SANITARY MANHOLES SHALL BE TESTED FOR LEAKAGE BY VACUUM TESTING PER CITY STANDARDS. THE MANHOLE FRAME AND ADJUSTING RINGS SHALL BE IN PLACE WHEN TESTING. ANY LEAKS SHALL BE REPAIRED FROM EXTERIOR MANHOLE - PATCHING INSIDE OF MANHOLE SHALL NOT BE EXCEPTABLE.

AT EACH JOINT, APPLY
A CONTINUOUS LAYER OF
NON-HARDENING PREFORMED
BITUMINOUS MASTIC MATERIAL,
CONSEAL CS-102B, OR APPROVED
EQUAL.



Naperville

CITY OF NAPERVILLE
DEPARTMENT OF WATER

TITLE:

SANITARY MANHOLE

SCALE:
NTS

DATE:
08/29/12

Detail:
SAN 1